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(71) Applicant: **RITE-HITE HOLDING CORPORATION** [US/US]; 8900 North Arbon Drive, Milwaukee, Wisconsin 53223 (US).

(72) Inventors: **PINKALLA, Cary**; 8320 N. Lake Drive, Fox Point, Wisconsin 53217 (US). **LOGIC, Jeff**; 3629 River Bend Drive, Racine, Wisconsin 53404 (US). **GEBKE, Kevin J.**; 2681 New Haven Street, Dubuque, Iowa 52001 (US). **KAUFMANN, Nicholas L.**; 13645 Mueller Parkway, Sherrill, Iowa 52073 (US).

(74) Agent: **SALMON, Scott D.**; Hanley, Flight & Zimmerman, Llc, 150 S. Wacker Drive, Suite 2200, Chicago, Illinois 60606 (US).

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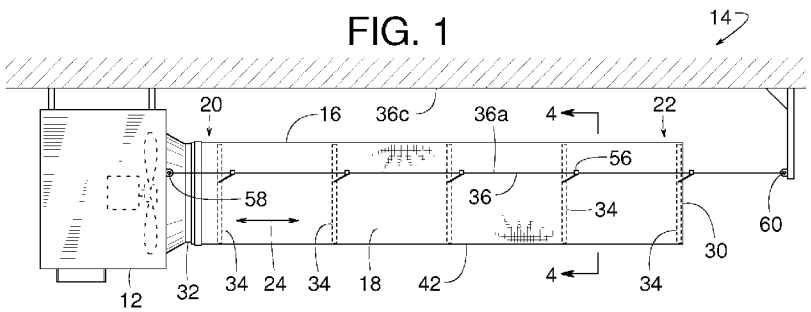
— *with international search report (Art. 21(3))*

— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))*

(88) Date of publication of the international search report:
4 February 2016

(54) Title: EXTERNALLY TENSIONED PLIABLE AIR DUCTS

FIG. 1



(57) Abstract: Example air duct assemblies include a pliable air duct supported such that the duct is maintained in a generally expanded shape even when the duct is deflated. In some examples, a series of hangers suspend the duct from one or more cables, tracks or other type of overhead support. The hangers are spaced apart and distributed over the length of the duct, and each one contributes in pulling the duct taut in the ducts longitudinal direction.

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INTERNATIONAL SEARCH REPORT

International application No
PCT/US2015/031356

A. CLASSIFICATION OF SUBJECT MATTER
INV. F24F13/02
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
F24F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2012/125472 A1 (PINKALLA CARY [US] ET AL) 24 May 2012 (2012-05-24)	41-45
A	abstract; figures 1,5 paragraphs [0035] - [0038]	1-11, 16-23
X	US 8 434 526 B1 (PINKALLA CARY [US] ET AL) 7 May 2013 (2013-05-07)	12-15, 28-35
A	abstract; figures 1,3, 5, 8, 9. 12 column 4, lines 47-63 column 6, lines 27-55	1-11, 16-23
A	EP 1 091 179 A1 (JOULE VENTURE HOLDING B V [NL]) 11 April 2001 (2001-04-11) abstract; figures 2,3 paragraphs [0013], [0014]	1-11, 16-23

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[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
3 December 2015	14/12/2015

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Salaün, Eric

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Form PCT/ISA/210 (second sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

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C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2004 116793 A (RYUKI ENGINEERING KK) 15 April 2004 (2004-04-15) abstract; figures 1-3 paragraphs [0015], [0016]	1-11, 16-23
X	US 2 091 265 A (BROWN WALLACE E) 31 August 1937 (1937-08-31)	28-35
A	page 2, left-hand column, lines 19-39; figure 6	1-11, 16-23
A	WO 01/04547 A1 (RITE HITE HOLDING CORP [US]) 18 January 2001 (2001-01-18) abstract; figures 13,14	1-11, 16-23

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2015/031356

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of additional fees.

3. ☒ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

1-23, 28-35, 41-45

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

☒ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-11

An air duct assembly comprising: an air duct having an inflated state and a deflated state, the air duct comprising a sidewall that is pliable, the sidewall defining an interior of the air duct and an external area outside the air duct; a first overhead support member in the external area outside the air duct; a second overhead support member in the external area outside the air duct, the first overhead support member and the second overhead support member defining a separation distance therebetween; a hoop disposed within the interior of the air duct, the hoop providing the sidewall with support in a radial direction that is substantially perpendicular to the longitudinal direction;a loop disposed within the interior of the air duct and fastening the hoop with respect to the sidewall;a first hanger coupling at least one of the sidewall, the loop, or the hoop to the first overhead support member, the first hanger transmitting a first pulling force that subjects the sidewall to tension in the longitudinal direction when the air duct is in the deflated state; and a second hanger coupling at least one of the sidewall, the loop, or the hoop to the second overhead support member, the second hanger transmitting a second pulling force that subjects the sidewall to tension in the longitudinal direction when the air duct is in the deflated state, the first hanger and the second hanger being spaced apart from each other by virtue of the separation distance between the first overhead support member and the second overhead support member.

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2. claims: 12-15

An air duct assembly for conveying air in a downstream direction, which is opposite an upstream direction, the air duct assembly comprising: an air duct having an inflated state and a deflated state, the air duct being elongate in a longitudinal direction, the air duct comprising a sidewall that is pliable, the sidewall to define an interior of the air duct and an external area outside the air duct; first and second cables or tracks radially offset relative to the air duct; a hoop providing the sidewall with support in a radial direction that is substantially perpendicular to the longitudinal direction; a first hanger coupled to at least one of the hoop or the sidewall and the first cable or track, a first pulling force being transferred to the hoop or the sidewall from the first hanger; and a second hanger radially spaced apart from the first hanger and coupled to at least one of the hoop or the sidewall and the second cable or track, a second pulling force being transferred to the hoop or the side wall from the second hanger, the first

and second hangers being independently couplable and adjustable relative to the respective first and second cables or tracks.

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3. claims: 16-23

An air duct assembly comprising: an air duct having an inflated state and a deflated state, the air duct being elongate in a longitudinal direction and extending from an upstream end to a downstream end, the air duct comprising a sidewall that is pliable, the sidewall being tubular to define an interior of the air duct and an external area outside the air duct; a cable or track; and first and second hangers suspending the air duct from the overhead support, the first and second hangers being spaced apart and distributed in the longitudinal direction between the upstream end and the downstream end, the first and second hangers being non-perpendicular and non-parallel relative to the longitudinal axis to apply tension to the sidewall in the longitudinal direction.

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4. claims: 24-27

An air duct assembly comprising: an air duct elongate in a longitudinal direction, the air duct comprising a sidewall that is pliable, the sidewall being tubular and defining an interior of the air duct and an external area outside the air duct;an overhead support member in the external area outside the air duct;a hoop disposed within the interior of the air duct, the hoop providing the sidewall with support in a radial direction that is substantially perpendicular to the longitudinal direction; and a bracket passing through an opening in the sidewall and extending from the hoop to the overhead support member, the bracket being more rigid than the sidewall, and the bracket cooperating with the hoop to subject the air duct to tension in the longitudinal direction, the bracket and the hoop being non-adjustably coupled.

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5. claims: 28-35

An air duct assembly comprising: an air duct elongate in a longitudinal direction, the air duct comprising a sidewall that is pliable, the sidewall defining an interior of the air duct and an external area outside the air duct;a cable or track; a first dual-hoop structure to provide the sidewall with support in a radial direction that is substantially perpendicular relative to the longitudinal direction; and a bracket connecting the first dual-hoop structure to the cable or track, the bracket being more rigid than the sidewall.

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6. claims: 36-39

An air duct assembly comprising: an air duct comprising a sidewall that is pliable, the sidewall defining an interior of the air duct; a first hoop disposed within the interior of the air duct, the first hoop providing the sidewall with support in a radial direction that is substantially perpendicular to the longitudinal direction; and a cable disposed within the interior of the air duct, the cable being elongate in the longitudinal direction, the cable engaging the first hoop to help support the weight of the first hoop and the sidewall.

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7. claim: 40

An air duct assembly comprising: an air duct comprising a sidewall that is pliable, the sidewall defining an interior of the air duct and an external area outside the air duct; and a strut being elongate in the longitudinal direction, the strut having opposite ends proximate the upstream end and the downstream end of the air duct, the strut being in compression between the upstream end and the downstream end subjects the sidewall to tension in the longitudinal direction.

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8. claims: 41-45

An air duct assembly comprising: an air duct comprising a sidewall that is pliable, the sidewall defining an interior of the air duct and an external area outside the air duct; and a curved strut elongate in the longitudinal direction, the curved strut having opposite ends proximate the upstream end and the downstream end of the air duct, the curved strut being in compression between the upstream end and the downstream end to subject the sidewall to tension in the longitudinal direction.

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9. claim: 46

An air duct assembly comprising: an air duct to have an inflated state and a deflated state, the air duct comprising a sidewall that is pliable, the sidewall to define an interior of the air duct and an external area outside the air duct; a first overhead support member to be in the external area outside the air duct; a second overhead support member to be in the external area outside the air duct, the first overhead support member and the second overhead support member to define a separation distance therebetween ;a hoop to be disposed within the interior of the air duct, the hoop to provide the sidewall with support in a radial direction that is substantially perpendicular to

the longitudinal direction;a loop to fasten the hoop with respect to the sidewall;a first hanger to couple at least one of the sidewall, the loop, or the hoop to the first overhead support member, the first hanger to transmit a first pulling force that subjects the sidewall to tension in the longitudinal direction when the air duct is in the deflated state; and a second hanger to couple at least one of the sidewall, the loop, or the hoop to the second overhead support member, the second hanger to transmit a second pulling force that subjects the sidewall to tension in the longitudinal direction when the air duct is in the deflated state, the first hanger and the second hanger being spaced apart from each other by virtue of the separation distance between the first overhead support member and the second overhead support member.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2012125472 A1	24-05-2012	AU 2011353077 A1	02-05-2013
		CA 2818114 A1	05-07-2012
		CN 103210260 A	17-07-2013
		EP 2641028 A1	25-09-2013
		US 2012125472 A1	24-05-2012
		US 2014000744 A1	02-01-2014
		US 2014007971 A1	09-01-2014
		US 2014261835 A1	18-09-2014
		WO 2012091795 A1	05-07-2012
US 8434526 B1	07-05-2013	AU 2012332430 A1	05-06-2014
		CA 2853280 A1	10-05-2013
		CN 103958981 A	30-07-2014
		EP 2773909 A2	10-09-2014
		US 8434526 B1	07-05-2013
		WO 2013067172 A2	10-05-2013
EP 1091179 A1	11-04-2001	AT 296997 T	15-06-2005
		DE 60020478 D1	07-07-2005
		DE 60020478 T2	11-05-2006
		DK 1091179 T3	15-08-2005
		EP 1091179 A1	11-04-2001
		ES 2240009 T3	16-10-2005
		NL 1013242 A1	17-04-2001
		NL 1013242 C2	23-04-2001
		PT 1091179 E	30-09-2005
JP 2004116793 A	15-04-2004	JP 3883483 B2	21-02-2007
		JP 2004116793 A	15-04-2004
US 2091265 A	31-08-1937	NONE	
WO 0104547 A1	18-01-2001	AU 6096600 A	30-01-2001
		US 6280320 B1	28-08-2001
		WO 0104547 A1	18-01-2001